3 years of Micro Rain Radar operation over NW Scotland

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What: MRR-2 (24.1 GHz vertically pointing radar)
Where: Stornoway, Lewis & Harris, Scotland.
Position 58°12'50.43"N, 6°23'54.28"W
When: June 2015 – present
Resolution: 1 minute sampling of 30x100m vertical bins
Parameters: precipitation rate, fall speed, drop size distribution, liquid water content.

In June 2015 a Micro Rain Radar (MRR) was installed in Stornoway, NW Scotland. The overall aim was to provide a long term record of precipitation characteristics in this region. The region is exposed to the North Atlantic weather systems, with contrasting mild southwesterly moist airflows, very cold Arctic weather, and dryer warm/cold airflow off the mainland of Scotland.

The information gained from this dataset includes providing some insight into i) the occurrence and contribution of light precipitation in this region, and ii) the vertical distribution of the precipitation – within the range of satellite radar retrievals.

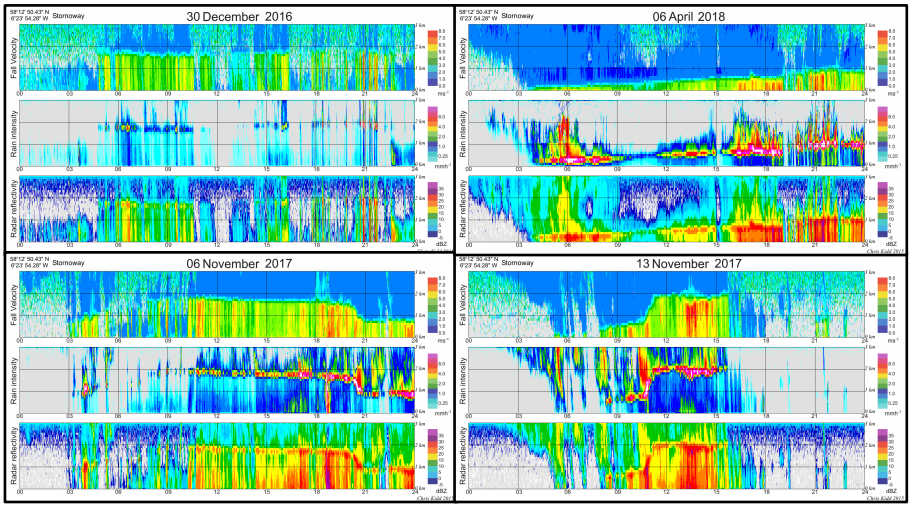
Headline findings:

Rain occurrence (all precipitation) 15%

Rain occurrence (>0.1 mmh^{-1}) 10%
(true across lowest c.1 km)

Annual Mean Rainfall c. 800-1000 mm
(no bright band correction)

Only c.12% of rain cases had brightbands
(height of maxRR & (W>3,W<3))

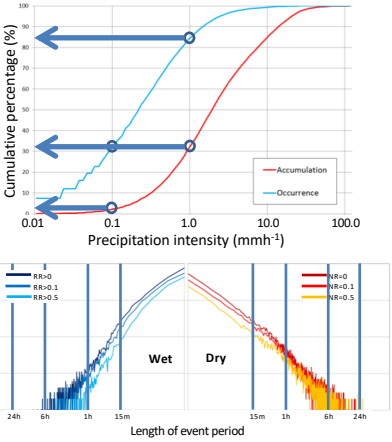


Examples of precipitation events showing (in each example) the fall velocity (top), rainrate (middle) and reflectivity (bottom). Note the changes in the fall speed, and a maximum rainrate that relate to the melting level. The low rainfall intensities (< 1.0 mmh^{-1}) are typical of this region through out the year, as are the sudden changes in the freezing level.

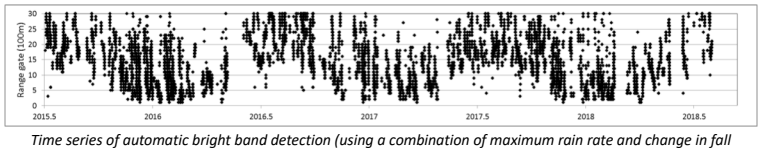
Initial analysis of the data has just commenced and concentrates upon the broad characteristics of precipitation, namely the occurrence of precipitation at the ground, the occurrences of precipitation intensities, and the characteristics of precipitation at the 1 km level and above (for better comparison with the satellite-based precipitation radars).

To the right is a 'classical' cumulative distribution plot for the occurrence and the accumulation versus precipitation intensity. The circled points note that 85% of the precipitation at the Stornoway site was at of less than 1 mmh^{-1} (contributing c. 32% of the accumulation), while about 32% of the precipitation fell at below 0.1 mmh^{1} (about 4% of the accumulation).

It is also possible to look at the wet/dry periods during the 3 years of operation (right). Here the number occasions that a dry period or a wet period of a certain length were recorded. Interestingly, it shows how variable the precipitation is with the majority of wet/dry periods lasting just 1 minute! There is also some asymmetry with dry periods being longer than wet periods (the longest dry period was about 4 days).



Analysis of longevity of dry/wet periods during the 3 years of operation: Surprisingly short event periods for both wet and dry.



Time series of automatic bright band detection (using a combination of maximum rain rate and change in fall velocity): the seasonal cycle being clear, although day-day variations greater than the general cycle.

Other information such as the freezing/melting level can be obtained through rudimentary schemes, as shown above. This provides information on the liquid water vs ice water content of the precipitation being observed.

It is envisaged that the current MRR will continue operating at the Stornoway site for the foreseeable future, allowing a long term record of precipitation characteristics to be built up over time.